IEEE P802.11
Wireless LANs

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| 802.11ah TXOP Limits |
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Abstract

This submission proposes a resolution for a post LB232 comment on 802.11ah TXOP Limits.

Revisions:

* Rev 0: Initial version of the document
* Rev 1: Modified proposal to allow support of packets sized for DHCP, for example, at low MCS rates but restrict TXOP limits for higher MCS rates

## Discussion

The original comment and current proposed change are below.

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| **CID** | **Commenter** | **Pg / Ln** | **Section** | **Comment** | **Proposed Change** |
|  | David Goodall | 1036/1 | 9.4.2.28 | For 802.11ah non-sensor STAs the default TXOP limit value for each AC is defined in Table 9-146. This value is the same as the values for IEEE 802.11ac, and is not suitable for the lower data rates of 802.11ah. For example, the TXOP limit for best effort traffic does not allow sufficient time for a non-sensor STA to transmit either TCP packets or ping packets using MCS10. | Provide a separate column in Table 9-156 for Clause 23 PHYs (802.11ah) in which the TXOP limit for each AC is set to a maximum of 15.008 milliseconds. Provide exceptions in Section 10.24.2.9 for an S1G non-sensor STA that allow the TXOP holder to exceed the TXOP limit in the following cases:* Transmission of an MSDU or MMPDU less than 600 octets
* Transmission of a fragment of an MSDU or MMPDU, the fragment being less than 600 octets
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The proposed changes apply to a Clause 23 (S1G) non-sensor STA. The exceptions allow smaller packets to be sent unfragmented at the lowest 802.11ah MCS rates. For example, a DHCP packet may be sent without fragmentation at MCS0 or MCS10 in a 1MHz channel. It is preferred not to fragment DHCP packets because of the extra time required to obtain an IP address, due to the backoff before accessing the medium, plus each fragment requires a preamble and is followed by SIFS and an NDP ACK (1.28 milliseconds additional fixed overhead per fragment at MCS10).

The intent is that the new exceptions cover the case of a whole MPDU (for a small packet) and the case of a fragment of an MPDU.

Note that the case for retries, potentially at a lower MCS rate, is covered in the existing exceptions in Section 10.24.2.9 TXOP limits:

— Retransmission of an MPDU, not in an A-MPDU consisting of more than one MPDU

### Alternative Approach

Another approach is to have a different TXOP limit per group of MCSs (or PHY rates). An S1G entry in Table 9-156 could look like this:

 For PHY rate > 300 kbps: 16.368 ms

 For PHY rate <= 300 kbps: 32.736 ms

A potential downside of this approach is that devices may now use A-MPDU at lower MCS to aggregate short packets and fill up the entire 32 ms TXOP. This is avoided with the exceptions approach.

### TXOP Limits for 802.11af (Clause 22) PHY

The comment resolution document for the 802.11af TXOP limit appears to be this one:

https://mentor.ieee.org/802.11/dcn/12/11-12-1373-01-00af-tgaf-default-txop-limit.docx

The solution selected for 802.11af includes a TXOP limit of 0 for AC\_BE, which means that a single packet can be transmitted in each TXOP. This is not a good solution for 802.11ah non-sensor STAs as it would be impossible to send an A-MPDU containing multiple MPDUs at higher MCS rates, while a single full size packet would take a very long time at the lowest S1G PHY rate.

There is further discussion on TXOP limits here:

<https://mentor.ieee.org/802.11/dcn/13/11-13-0014-01-000m-txop-limits.pptx>

The 802.11ah PHY differs from the PHYs discussed in this document and supports rates down to 150 Kbps (MCS10 in 1 MHz). Note that the smallest fragmentation threshold in 802.11 is 256 bytes in length and a packet this size takes almost 15 milliseconds to transmit, and receive an ACK, using MCS10 in an 802.11ah 1MHz channel.

The use cases for 802.11ah do not preclude voice and video but spectrum is not necessarily available in all geographies for these types of applications. In geographies where duty cycles are required these applications are more likely to be combined with a sensor, e.g. a doorbell with low bit rate audio/video capability to help identify callers. The exceptions recommended for resolving the 802.11ah TXOP limit issue support low rate audio/video from an outside gate at the edge of the BSS, for example.

## Proposed Resolution

**REVmd draft 1.4**

***Modify as shown.***

**9.4.2.28 EDCA Parameter Set element**

1092.13

Table 9-156 (Default EDCA Parameter Set element parameter values if dot11OCBActivated is false or (11ah)the STA is a non-sensor STA) defines the default EDCA parameter values used by a non-AP STA if dot11OCBActivated is false.[[1]](#footnote-1)

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| --- | --- |
|  | * Default EDCA Parameter Set element parameter values if dot11OCBActivated is false or (11ah) the STA is a non-sensor STA
 |
| AC | CWmin | CWmax | AIFSN | TXOP limit |
| For PHYs defined in Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM -applications) and Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY -specification) | For PHYs defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification), Clause 18 (Extended Rate PHY (ERP) specification), Clause 19 (High-throughput (HT) PHY specification), Clause 21 (Very high throughput (VHT) PHY specification) | For PHY defined in Clause 22 (Television very high throughput (TVHT) PHY specification) | Clause 23 (Sub 1 GHz (S1G) PHY specification(11ah)) (11ah) | Other PHYs |
| AC\_BK | aCWmin | aCWmax | 7 | 3.264 ms | 2.528 ms | 0 | 15.008 ms | 0 |
| AC\_BE | aCWmin | aCWmax | 3 | 3.264 ms | 2.528 ms | 0 | 15.008 ms | 0 |
| AC\_VI | (aCWmin+1)/2 – 1 | aCWmin | 2 | 6.016 ms | 4.096 ms | 22.56 ms (BCU: 6 or 7 MHz), 16.92 ms (BCU: 8 MHz) | 15.008 ms | 0 |
| AC\_VO | (aCWmin+1)/4 – 1 | (aCWmin+1)/2 – 1 | 2 | 3.264 ms | 2.080 ms | 11.28 ms (BCU: 6 or 7 MHz),8.46 ms (BCU: 8 MHz) | 15.008 ms | 0 |

* TXOP limits

1784.46

The duration of a TXOP is the time a STA obtaining a TXOP (the TXOP holder) maintains uninterrupted control of the medium, and it includes the time required to transmit frames sent as an immediate response to TXOP holder transmissions. The TXOP holder shall, subject to the exceptions below, ensure that the duration of a TXOP does not exceed the TXOP limit, when nonzero.

The TXOP limits are advertised by the AP in the EDCA Parameter Set element in Beacon and Probe Response frames transmitted by the AP.

A TXOP limit of 0 indicates that the TXOP holder may transmit or cause to be transmitted (as responses) the following within the current TXOP:

* One of the following at any rate, subject to the rules in 10.6 (Multirate support)
* One or more SU PPDUs carrying fragments of a single MSDU or MMPDU
* An SU PPDU or a VHT MU PPDU carrying a single MSDU, a single MMPDU, a single A‑MSDU, or a single A-MPDU
* A VHT MU PPDU carrying A-MPDUs to different users (a single A-MPDU to each user)
* A QoS Null frame or PS-Poll frame (11ah)that is not an PS-Poll+BDT frame
* Any required acknowledgments
* Any frames required for protection, including one of the following:
* An RTS/CTS exchange
* CTS to itself
* Dual CTS as specified in 10.3.2.10 (Dual CTS protection)
* Any frames required for beamforming as specified in 10.32 (Sounding PPDUs), 10.37.5 (VHT sounding protocol) and 10.43 (DMG beamforming).
* Any frames required for link adaptation as specified in 10.33 (Link adaptation)
* Any number of BlockAckReq frames

NOTE 1—This is a rule for the TXOP holder. A TXOP responder need not be aware of the TXOP limit nor of when the TXOP was started.

NOTE 2—This rule prevents the use of RD(11ah), BDT, and TXOP sharing when the TXOP limit is 0.

When dot11OCBActivated is true, TXOP limits shall be 0 for each AC.

The TXOP holder may exceed the TXOP limit only if it does not transmit more than one Data or Management frame in the TXOP, only if it does not transmit a DL MU-MIMO PPDU in the TXOP,(#163) and only for the following situations:

* Retransmission of an MPDU, not in an A-MPDU consisting of more than one MPDU
* Transmission of an MSDU or MMPDU less than 600 octets by an S1G non-sensor STA
* Transmission of a fragment of an MSDU or MMPDU, the fragment being less than 600 octets, by an S1G non-sensor STA
* Initial transmission of an MSDU under a block ack agreement, where the MSDU is not in an A-MPDU consisting of more than one MPDU and the MSDU is not in an A‑MSDU
* Transmission of a Control MPDU or a QoS Null MPDU, not in an A-MPDU consisting of more than one MPDU
* Initial transmission of a fragment of an MSDU or MMPDU, if a previous fragment of that MSDU or MMPDU was retransmitted
* Transmission of a fragment of an MSDU or MMPDU fragmented into 16 fragments
* Transmission of an A-MPDU consisting of the initial transmission of a single MPDU not containing an MSDU and that is not an individually addressed Management frame
* Transmission of a group addressed MPDU, not in an A-MPDU consisting of more than one MPDU
* Transmission of a null data packet (NDP)
* Transmission of a VHT NDP Announcement frame and NDP or transmission of a Beamforming Report Poll frame, where these fit within the TXOP limit and it is only the response and the immediately preceding SIFS that cause the TXOP limit to be exceeded.

Except as described above, a STA shall fragment an individually addressed MSDU or MMPDU so that the initial transmission of the first fragment does not cause the TXOP limit to be exceeded.

NOTE—The TXOP limit is not exceeded for the following situations:

* Initial transmission of an MPDU containing an unfragmented though fragmentable (see 10.2.6 (Fragmentation/defragmentation overview)) MSDU/MMPDU
* Initial transmission of the first fragment of a fragmented MSDU/MMPDU, except for an MSDU/MMPDU fragmented into 16 fragments
* Initial transmission of an A‑MSDU
* Initial transmission of a fragment of a fragmented MSDU/MMPDU, if no previous fragment of that MSDU/MMPDU was retransmitted, except for an MSDU/MMPDU fragmented into 16 fragments
* Transmission of an A-MPDU consisting of a single MPDU containing an A MSDU or individually addressed Management frame, unless this is a retransmission of that MPDU
* Transmission of an A-MPDU consisting of more than one MPDU, even if some or all of the MPDUs are retransmissions

If the TXOP holder exceeds the TXOP limit, it should use as high a PHY rate as possible to minimize the duration of the TXOP.

The duration of a TXOP for a mesh STA that has dot11MCCAActivated true shall not exceed the time between the start of the TXOP and the end of the current MCCAOP reservation.

NOTE—The rules in this subclause also apply to priority-downgraded MSDUs and A‑MSDUs (see 10.24.4.2 (Contention based admission control procedures).

1. The default values for TXOP limit are expressed in milliseconds and are multiples of 32 s. [↑](#footnote-ref-1)